IN THE SPECIFICATION

Please substitute the paragraph beginning on page 2, line 24, third full paragraph on page 2, with the following paragraph:

B1

Some prior computer graphics techniques used for fur creation have achieved convincing looks of smooth fur; however, these techniques do not take into account that real fur often breaks up at certain areas of the body, such as around the neck. In addition, the prior methods do not account for hairs of wet fur that clump together resulting in a significantly different appearance compared to dry fur. Also, the process of simulating hair as it is getting increasingly wet when sprinkled on by water has not yet been addressed.

Please substitute the paragraph beginning on page 6, line 20, third full paragraph on page 6, with the following paragraph:

B2

An alternate embodiment is illustrated in **Figure 1b**. Input is received by surface definition module 50 that defines a surface which, as will be explained below, defines surfaces and control hairs of the object to be rendered. Module 55 adjusts the control hairs to provide such functionality as combing and seamless hairs across surface boundaries. The interpolator module 60 interpolates across the surfaces using the control hairs. Hair clumping and breaking module 65 enhances the realistic visualization of the object by providing for clumping and breaking of hairs. Rendering module 70 renders the hairs and provides shading, black lighting and shadowing effects to the hairs, and module 75 displays the final output of the object with the hair surfaces

Please substitute the paragraph beginning on page 8, line 19, second full paragraph on page 8, with the following paragraph:

B3

At step 400, seams are constructed between adjacent surfaces. Each seam identifies adjacent surfaces along a corresponding boundary (for example, an entire edge, T-junctions, or corners) of a surface patch. At step 405, for each surface patch, the boundaries are traversed, step 410. Each control hair is examined, step 412. At step 415, if a boundary hair is found, at step 420, the neighboring patches, as identified by a corresponding seam, are checked to see if there is a corresponding hair on the

neighboring patch. In one embodiment, a hair is corresponding if it is within a small predetermined distance from the boundary hair. The distance may be specified in parametric *u, v,* or absolute space. In one embodiment, the predetermined distance may be a relatively small distance such that the hairs visually appear co-located.

B3

Please substitute the paragraph beginning on page 10, line 23, fourth full paragraph on page 10, with the following paragraph:

As noted above, animated combing may also be applied, step 345. Key framing, known in the art, is used to interpolate between combing changes specified at certain frames to proving smooth transitions between changes. Thus for example, bend curvature and fallout parameters may be specified to change at certain frames. The key framing process execution then transitions during the frames between the specified frame changes. This technique can be used to simulate a variety of conditions which affect the look of the hair, such as wind. Thus, the hairs can be animated by key framing the parameters and executing the combing calculations at each frame during playback.

B4

Please substitute the paragraph beginning on page 11, line 11, second full paragraph on page 11, with the following paragraph:

The process includes an iterative algorithm that determines hair/surface intersections. For example, the process performs a line segment intersection check of successive control vertices of a curve (e.g., the NURBS curve) defining a control hair with the surface. If a control vertex *c* goes below the surface, the hair is rotated back towards the surface normal from the previous non-intersecting vertex just enough for *c* to clear the surface. The amount of rotation is large enough to cause the hair to rotate back up above the surface by a small amount specified by the application. Thus the vertices of the vector affected by the combing are rotated back towards the surface normal so that the vector is above the surface.

B5

Please substitute the paragraph beginning on page 11, line 20, second full paragraph on page 11, with the following paragraph:

In an alternate embodiment, the combing may be animated by turning each control vertex of a control hair into a particle, and applying dynamic effects like gravity and external forces. Software, such as Maya™ available by Alias|Wavefront, a division of Silicon Graphics, Inc., Toronto Canada, may be used to perform this function.

B6

Please substitute the paragraph beginning on page 11, line 29, ending on page 12, line 4, with the following paragraph:

B7

One exemplary process for the placement of hairs on patches is illustrated by the flow chart of **Figure 5**. In this embodiment, final hairs are generated from control hairs in two set steps. First, the static hair features are calculated, e.g., the placement (the *u, v* position) of the final hairs. This step may be performed once. The second set of steps may be performed for each frame in an animation and provide frame dependent hair features.

Please substitute the paragraph beginning on page 13, line 13, second full paragraph on page 13, with the following paragraph:

B8

At step 530, the final hairs are placed. Since it is preferable not to place fractional hairs, either 3 or 4 hairs are placed depending on whether a uniformly generated random number in [0,1] is bigger or smaller than the fractional part (0.5999). The 3 or 4 control hairs are randomly placed in u [ui, ui+1] and randomly in v [vi, vi+1]. The process then proceeds back to step 510 to the subpatch defined by the next four equally spaced points.

Please substitute the paragraph beginning on page 13, line 19, third full paragraph on page 13, with the following paragraph:

B9

Each final hair contains a number of control vertices. The root position (first control vertex) of each control hair is specified in terms of a (u,v) value of the underlying surface. The remaining control vertices of each hair are defined in a known local coordinate system with origins specified at the hair root position, and axes in the direction of the surface normal, *du, dv*. In one embodiment, each hair is oriented along the surface normal and the coordinates of the control vertices are generated by subdividing the length of each hair into n-1 equal parts, where n is the number of control vertices/hair. One

example is illustrated in **Figure 7a**, where a hair 725 is defined on surface 730 with n=4. The root is vertex 720 and the remaining vertices are 705, 710 and 715.

Please substitute the paragraph beginning on page 13, line 25, ending on page 14, line 4, with the following paragraph:

B9

Once the root position is calculated the enclosing control hairs (in one embodiment three) for each final hair are determined. In one embodiment, a 2-dimensional Delaunay triangulation (known in the art and therefore not further discussed herein) is constructed of the *(u, v)* positions of the control hairs for each surface patch. This triangulation was chosen because it creates "well-proportioned" triangles, by minimizing the circumcircle and maximizing the minimal angles of the triangles. Once the Delaunay triangulation is constructed, it is determined which triangle each final hair falls into. The indices of the three control hairs which form the particular triangle are assigned to the hair that falls into that triangle.

Please substitute the paragraph beginning on page 14, line 11, second full paragraph on page 14 with the following paragraph:

B10

The above information of each final hair (i.e., the *(u, v)* position, the 3 enclosing control hairs, and the weights of each control hair) may be generated only once for an object in animation. This information is referred to herein as the static information. In contrast, the calculation of the orientation of each final hair may be done at each frame of an animation. This orientation is determined from the orientation of the control hairs and their corresponding weights by an interpolation process as explained with reference to **Figures 7c and 7d**.

Please substitute the paragraph beginning on page 16, line 17, third full paragraph on page 16 with the following paragraph:

B11

Referring to **Figure 8**, to determine clump membership of each final hair (i.e., what clump each hair belongs to, if any), the clump of the specified clump-size is converted into *u*-radius and *v*-radius components in parametric surface space at each clump-center hair location, step 800. Each hair is evaluated at steps 805, 810 to

determine whether it falls within the *u, v* radius components of a corresponding clump-center hair. If the hair is not within the *u, v* radius components, the hair is not a clump hair, step 815 and the process continues, step 830, with the next hair. If the hair is within the *u, v* radius components, at step 820 the clump-center hair's index is referenced with the hair. In addition, a clump rate and clump percent is assigned, step 825.

i

B11

Please substitute the paragraph beginning on page 16, line 25, ending on page 17, line 3, with the following paragraph:

A number of variations are contemplated. A clump-size noise parameter may be introduced to produce random variations in the size of the clumps. Feature (texture) maps for a clump-size can be created and specified by the user, one per surface patch, to provide local control of the radii used at steps 805, 810. In this embodiment, the global clump-size input parameter is multiplied for a particular clump (clump center hair) at *u, v* on a surface patch with the corresponding normalized (s,t) value in the clump-size feature map for that surface. Also, a static clump-area feature map can be provided to limit clumping to specified areas on surface patches rather than the whole model.

Please substitute the paragraph beginning on page 17, line 25, ending on page 18, line 7, with the following paragraph:

B12

In one embodiment, this process is performed at each frame. In one embodiment, the default value for number of control vertices (CVs) is 3 (4 minus the root vertex), and the index for the current control vertex *i* ranges from 1-3. In one embodiment, the reorientation is determined as follows:

clumpHairCV[i] = clumpHairCV[i]+delta* (clumpCenterHairCV[i] -clumpHairCV[i])

delta = clumpPercent *(fract + clumpRate* (1 - fract)); where fract = i / numberOfCVs; clumpHairCV[i] represents a clump hair vertex; clumpCenterHairCV[i] represents a corresponding clump center hair vertex; i represents an index to a current control vertex; numberofCVs represents the number of control vertices of a clump hair; clumpPercent represents clump-percent; and clumpRate represents the clump-rate.

Please substitute the paragraph beginning on page 19, line 13, third full paragraph on page 19 with the following paragraph:

For each particle that hits a surface patch, including those particles generated in prior frames, a circular animated clumping area is created, step 1115, on the patch at that *u, v* location, with clump-percent, clump-rate, and animated clumping area radius determined by a creation expression executed at the frame where the particle hits the surface so that when a particle hits the surface at that time (i.e., at the frame), the clump-percent may be set to zero and the radius may be defined to a specified value perhaps adjusted by a random noise value. Thus, the expression may be defined to provide the desired "wetness" effect.

B13

Please substitute the paragraph beginning on page 19, line 21, fourth full paragraph on page 19 with the following paragraph:

The radius of the circular clumping area defined is converted into a corresponding *u*-radius and *v*-radius similar to the clump size discussed above. Runtime expressions executed at each frame define clump-percent and clump-rate, thus determining how quickly and how much the fur "gets" wet. For example, one runtime expression may be: MIN(FrameNumber * 0.1, 1) such that as the frame number increases, the hair appears increasingly wet.

Please substitute the paragraph beginning on page 19, line 26, ending on page 20, line 3, with the following paragraph:

Each clump center hair of a clump (determined at step 1100) is then evaluated to determine if it falls within the animated clumping area, step 1120. To determine whether a clump falls within an animated clumping area, at each frame it is checked as to whether the (*u, v*) distance between the clump-center hair of the clump and the center of the animated clumping area is within the (*u, v*) radius parameters of the animated clumping area. For clumps that are located in overlapping animated clumping areas, the values for clump-percent and clump-rate are added resulting in the generation of wetter fur.

Please substitute the paragraph beginning on page 20, line 26, ending on page 21, line 2, with the following paragraph:

B14

In one embodiment, this potential problem is addressed. Whenever a new particle hits a surface and the (u, v) radii exceed the boundaries of that surface; an additional (u, v) center and (u, v) radii is generated for the animated clumping areas affecting neighboring patches. Thus, for example, if the clumping area covers portions of two neighboring patches, a corresponding (u, v) center and radii are generated for each neighboring patch to provide additional animated clumping areas for evaluation at steps 1120-1140.

Please substitute the paragraph beginning on page 21, line 24, ending on page 22, line 7, with the following paragraph:

B15

One embodiment of the hair breaking technique is illustrated by **Figure 12a**. At step 1200 the fur tracks are defined. The fur tracks may be defined similar to clumps by defining a (u, v) break radii. At step 1205 the break line hairs (hairs which lie on or are very close to the fur-track curve defined by the curve defined for the fur track) are computed. Using the break line hairs and break radii, at steps 1215, 1220, each hair is evaluated to determine whether the hair lies within the (u, v) break radii on both sides of the break line hairs in case of symmetric breaking, or to one side specified by the break vector (the break vector side) in case of one- sided breaking. For each hair within the space specified by the radii, referred to herein as a break hair, the corresponding break line hair (hair on the fur track) is then determined as the one closest to it. The hairs are labeled as break line hairs, break hairs with indices to their corresponding break line hairs, or normal hairs that do not reside within the areas specified by the break.

IN THE DRAWINGS

Please refer to the attached drawings and the Request to Approve Drawing Changes.

IN THE CLAIMS

Please cancel claims 1-11 without prejudice. Please add new claims 12-64.

12. (New) A method comprising:

modifying at least one area of hair to provide a visual effect to the area of hair in response to an external influence, comprising for each area;

identifying a hair of a plurality of hairs of the area as a center hair,

identifying an area size,

indicating at least one area parameter,

determining hairs of the plurality of hairs that are within the area as area hairs, the area located according to the center hair and the area size, and

orienting the area hairs according to at least one area parameter.

13. (New) The method as set forth in claim 12, wherein the visual effect is selected from the group comprising clumping of hairs and breaking of hair.

14. (New) The method as set forth in claim 12, wherein the at least one area parameter is dynamically varied to provide animated effects.

15. (New) A method for generating hairs on a surface comprising:

placing control hairs on each surface patch of surface patches on a surface;

indicating a global density value for hairs;

defining local points which define an area of the surface to be processed;

approximating sub-areas defined by polygons;

averaging a number of hairs per square unit area across sub-areas;

determining a total number of hairs per unit area; and

placing hairs in the sub-areas according to the total number of hairs per unit area.

16. (New) A method comprising:

modifying at least one area of hair to provide a visual effect of clumping of hairs in response to an external influence, comprising for each area;

identifying a hair of the plurality of hairs as a center hair,

identifying an area size,

indicating at least one clump parameter,

determining hairs of the plurality of hairs that are within the area as area hairs, the area located according to the center hair and the area size, and

orienting the area hairs according to at least one parameter.

17. (New) The method as set forth in claim 16, wherein the at least one clump parameter is dynamically varied to provide at least one animated effect.

18. (New) The method as set forth in claim 17, wherein the animated effect comprises simulating water hitting hairs and making the hairs increasingly wet.

19. (New) A method comprising:

B16

modifying at least one area of hair of a plurality of hairs to provide a visual breaking effect in response to an external influence, comprising for each area;

identifying a hair of the plurality of hairs as a center hair, said center hair comprising a break line hair,

identifying an area size,

indicating at least one area parameter,

determining hairs of the plurality of hairs that are within the area as area hairs, the area located according to the center hair and the area size, and

orienting the area hairs according to at least one area parameter.

20. (New) The method as set forth in claim 19, wherein symmetric breaking is performed, said step of orienting comprises reorienting hairs with respect to a corresponding hair.

21. (New) The method as set forth in claim 19, wherein one-sided breaking is performed, said step of orienting comprises reorienting hairs away from a corresponding break line hair.

22. (New) The method as set forth in claim 19, wherein the at least one area parameter is dynamically varied to provide animated effects.

23. (New) The method as set forth in claim 22, wherein the animated effect comprises simulating water hitting hairs and making the hairs increasingly wet.

24. (New) A method comprising:

modifying at least one area of hair to provide a visual groomed effect, comprising for each area;

creating at least one combing direction curve,

assigning at least one control hair,

defining at least one area parameter for the combing direction curve, and

orienting the control hair towards the combing direction curve.

25. (New) The method as set forth in claim 24, wherein the at least one area parameter are selected from the group comprising bend, curvature, and fall-off.

26. (New) The method as set forth in claim 24, wherein assigning at least one control hair further comprises identifying a control hair including at least one control vertex located below an underlying surface.

27. (New) The method as set forth in claim 24, wherein orienting the control hair towards the combing direction curve further comprises rotating the control hair above an underlying surface.

28. (New) A method comprising:

obtaining a shading normal for at least one point on a hair;

calculating an intensity at a point on the hair;

selectively shortening at least one hair based upon at least one parameter.

29. (New) The method as set forth in claim 28, wherein obtaining a shading normal further comprises mixing a surface normal with a normal vector at a plurality of points on the hair.

30. (New) The method as set forth in claim 29, wherein mixing a surface normal with a normal vector further comprises calculating an angle between a tangent vector at the plurality of points on the hair and a surface normal vector at a base position of the hair and adjusting the contribution of the surface normal and the normal vector to the shading normal based on the angle.

31. (New) The method as set forth in claim 28, wherein the at least one parameter are selected from the group comprising hair length and hair density.

32. (New) A method comprising:

constructing a seam between at least two adjacent surface patches;

identifying a boundary hair of a first surface patch along the seam; and

checking a second surface patch for a corresponding boundary hair.

33. (New) The method as set forth in claim 32 further comprising aligning the boundary hair of the first surface patch with the corresponding boundary hair of the second surface patch.

34. (New) The method as set forth in claim 33, wherein aligning the boundary hair of the first surface patch with the corresponding boundary hair of the second surface patch further comprises modifying a location of the boundary hair of the first surface patch and a location of the corresponding boundary hair of the second surface patch to a common location.

35. (New) The method as set forth in claim 33, wherein aligning the boundary hair with the corresponding boundary hair of the second surface patch further comprises

snapping the corresponding hair of the second surface patch to a location of the boundary hair of the first surface patch.

36. (New) The method as set forth in claim 32 further comprising determining the absence of a corresponding boundary hair of the second surface patch, and inserting a corresponding boundary hair of the second surface patch.

37. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

modifying at least one area of hair to provide a visual effect to the area of hair in response to an external influence, comprising for each area;

identifying a hair of a plurality of hairs of the area as a center hair,

identifying an area size,

indicating at least one area parameter,

determining hairs of the plurality of hairs that are within the area as area hairs, the area located according to the center hair and the area size, and

orienting the area hairs according to at least one area parameter.

38. (New) The computer readable medium as set forth in claim 37, wherein the at least one area parameter is dynamically varied to provide animated effects.

39. (New) The computer readable medium as set forth in claim 38, wherein the animated effect comprises simulating water hitting hairs and making the hairs increasingly wet.

40. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

defining surface patches on the surface area;

placing control hairs on each surface patch;

indicating a global density value for hairs;

defining local points which define an area of the surface to be processed;

approximating sub-areas defined by polygons;

averaging a number of hairs per square unit area across sub-areas;

determining a total number of hairs per unit area; and

placing hairs in the sub-areas according to the total number of hairs per unit area.

41. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

modifying at least one area of hair to provide a visual effect of clumping of hairs in response to an external influence, comprising for each area;

identifying a hair of the plurality of hairs as a center hair,

identifying an area size,

indicating at least one clump parameter,

determining hairs of the plurality of hairs that are within the area as area hairs, the area located according to the center hair and the area size, and

orienting the area hairs according to at least one parameter.

42. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

modifying at least one area of hair of a plurality of hairs to provide a visual breaking effect, comprising for each area;

identifying a hair of the plurality of hairs as a center hair, said center hair comprising a break line hair,

identifying an area size,

indicating at least one area parameter,

determining hairs of the plurality of hairs that are within the area as area hairs, the area located according to the center hair and the area size, and

orienting the area hairs according to at least one area parameter.

43. (New) The computer readable medium as set forth in claim 42, wherein symmetric breaking is performed, said orienting comprising reorienting hairs with respect to a corresponding hair.

44. (New) The computer readable medium as set forth in claim 42, wherein one-sided breaking is performed, said orienting comprising reorienting hairs away from a corresponding break line hair.

45. (New) The computer readable medium as set forth in claim 42, wherein the at least one area parameter are selected from the group comprising break-percent, break-rate, and break vector.

46. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

modifying at least one area of hair to provide a visual groomed effect, comprising for each area;

creating at least one combing direction curve,

assigning at least one control hair,

defining at least one area parameter for the combing direction curve, and

orienting the control hair towards the combing direction curve.

47. (New) The computer readable medium as set forth in claim 46, wherein the at least one area parameter are selected from the group comprising bend, curvature, and fall-off.

48. (New) The computer readable medium as set forth in claim 46, wherein assigning at least one control hair further comprises identifying a control hair including at least one control vertex located below an underlying surface.

49. (New) The computer readable medium as set forth in claim 46, wherein orienting the control hair towards the combing direction curve further comprises rotating the control hair above an underlying surface.

50. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

obtaining a shading normal for at least one point on a hair;

calculating an intensity at a point on the hair; and

selectively shortening at least one hair based upon at least one parameter.

51. (New) The computer readable medium as set forth in claim 50, wherein obtaining a shading normal further comprises mixing a surface normal with a normal vector at a plurality of points on the hair.

52. (New) The computer readable medium as set forth in claim 51, wherein mixing a surface normal with a normal vector further comprises calculating an angle between a tangent vector at the plurality of points on the hair and a surface normal vector at a base position of the hair and adjusting the contribution of the surface normal and the normal vector to the shading normal based on the angle.

53. (New) A computer readable medium containing executable instructions which, when executed in a processing system, cause the system to perform a method comprising:

constructing a seam between at least two adjacent surface patches;

identifying a boundary hair of a first surface patch along the seam; and

checking a second surface patch for a corresponding boundary hair.

54. (New) The computer readable medium as set forth in claim 53 further comprising aligning the boundary hair of the first surface patch with the corresponding boundary hair of the second surface patch.

55. (New) The computer readable medium as set forth in claim 53 further comprising determining the absence of a corresponding boundary hair of the second surface patch, and inserting a corresponding boundary hair of the second surface patch.

56. (New) A system for generating hairs comprising:

a surface definition module configured to define at least one surface of an object;

an interpolation module configured to interpolate and generate a plurality of hairs across at least one surface; and

a hair clumping and breaking module configured to identify a hair of the plurality of hairs as a center hair, identify an area size, indicate at least one area parameter, determine hairs of the plurality of areas that are within the area as area hairs, the area located according to the center hair and the area size, and orient the area hairs according to at least one area parameter.

57. (New) The system as set forth in claim 56 further comprising a control hair adjustment module configured to adjust center hairs to provide visual effects selected from the groups consisting of combing and seamless hairs across surface boundaries.

58. (New) The system as set forth in claim 56 further comprising a rendering module configured to provide shading, back lighting and shadowing effects to the hairs.

59. (New) The system as set forth in claim 56, wherein the visual effect is selected from the group comprising clumping of hairs and breaking of hair.

60. (New) The system as set forth in claim 56, wherein the at least one area parameter are selected from the group comprising clump-percent, clump-rate, break-rate, break-percent and break-vector.

61. (New) The system as set forth in claim 56, wherein the visual effect is breaking, said center hair comprising a break line hair that lies approximately on a fur track.

62. (New) A system comprising:

a memory configured to share data representative of a plurality of hairs; and

a processor coupled to the memory and configured to modify at least one area of hair to provide a visual effect in response to an external influence, comprising for each area;

identifying an area size, indicating at least one area parameter,

determining hairs of the plurality of areas that are within the area as area hairs, the area located according to a center hair and area size, and

orienting the area hairs according to at least one area parameter.

13/4

63. (New) The system as set forth in claim 62, further comprising a display configured to display an object comprising modified areas of hairs.

64. (New) The system as set forth in claim 62, wherein the visual effect is selected from the group comprising clumping of hairs and breaking of hair.